SECTION 6
SANITARY SEWAGE FORCE MAIN

6.1 GENERAL

6.2 DESIGN STANDARDS

6.21 Reference
6.22 System Design
6.23 Operational Cost Considerations

6.3 STANDARD REQUIREMENTS

6.31 General
6.32 Joint Restraining
6.33 Pipe Depth and Protection
6.34 Air and Vacuum Venting
6.35 Valve Locations
6.36 Branch Connections
6.37 Clean Out Connections
6.38 Terminal Discharge
6.39 Identification

6.4 TESTING

SECTION 6
SANITARY SEWAGE FORCE MAIN

6.1 GENERAL

A) This section includes the general requirements for design and installation of force main systems serving sanitary sewage pumping stations.

B) The relevant provisions of other sections of this specification shall be applicable to this section unless otherwise indicated herein or approved by the City.

6.2 DESIGN STANDARDS

6.21 Reference

The Developer shall comply with the applicable criteria set forth in WEF Manual of Practice No. 9, Latest Edition, the Recommended Standards for Wastewater Facilities, Latest Edition, and the Department of Environmental Protection requirements. Additionally, ASCE publication Pipeline Design for Water and Wastewater may be used as a design guide, if not in conflict with other requirements.

6.22 System Design

Force Main systems shall be of adequate size to efficiently transmit the total ultimate peak operational flows, applied by the connected sewage pumping station(s) to the effluent point. Consideration shall be given to possible future connection of other gravity sewer pump stations and force mains and this probability shall be reviewed with the City. Capacity computations shall be coordinated with the proposed pumping system(s), along with any future flow requirements, if applicable in order to provide adequate pipeline cleansing. Force main flow velocity shall not be less than 2 feet per second at ultimate design minimum pumping capacity, however, with multiple pumping station systems or phase development, this requirement may be difficult to meet and the system design shall receive special attention regarding cleaning, maintenance, pumping rates, future upgrading of systems by changing impellers, pump changes, parallel force mains and other ways to increase future capability.

6.23 Operational Cost Considerations

In addition to initial capital expenditure, long term pumping station operational costs shall also receive consideration when sizing force main systems or making decisions concerning whether gravity service or lift station service is to be provided.

6.3 STANDARD REQUIREMENTS

6.31 General

The materials of construction and general installation procedures shall comply with the specific applicable standards set forth under Section 2, "Utility Excavation, Trenching and Backfilling", Section 3, "Boring and Jacking", and Section 4, "Pipe, Fittings, Valves and Appurtenances".

Minimum force main diameter shall be 4".

6.32 Joint Restraining

"Mega-Lug" restrained joints shall be provided at all bends, wyes, tees, caps, valves, and reducers. If any joints are within the required restrained length they shall be restrained with a restraining harness as required. The restraints will be sized and placed according to the plans or according to the pipe manufacturer's recommendations when not shown on the plans.

6.33 Pipe Depth and Protection

The standard minimum cover for sewage force main systems shall be 36 inches from the top of the pipe to finish grade. Where this condition cannot be met, special consideration will be given. Additional depth may be required where future surface improvements are planned or anticipated.

6.34 Air and Vacuum Venting

Where the force main profile is such that air pockets or entrapment could occur resulting in flow blockage, provisions for automatic air release and/or venting shall be provided. Where free flow will occur during operation or after pumping stops, combined air release and vacuum valve assemblies shall be provided.

6.35 Valve Locations

Valves shall be installed on all subsidiary force mains at the point of connection to the major main and where force mains are to be extended and at intervals not exceeding 1,000 feet. At future connection branches or ends, the valves shall be restrained by methods to facilitate said connection without system shut down.

6.36 Branch Connections

Branch connections are not allowable. All force mains must terminate at manholes, wetwells, or force mains. Force mains shall not terminate into gravity sewers.

6.37 Clean Out Connections

Should force mains appear to be susceptible to sedimentation clogging, as created by depressed crossings or extended low flow (velocity) periods, suitable clean out connections shall be provided.

6.38 Terminal Discharge

Force mains shall enter the terminal facility (gravity sewer manhole, pumping station wet well, or other) at a point equal to the operational water level of said receiving unit. Should an elevation drop be required to obtain the outlet connection, the prior down-slope of the force main shall not exceed 45 degrees, and adequate air venting shall be provided at the profile breakpoint.

6.39 Identification

In order to preclude possible domestic water tapping, all installed underground sanitary sewage force mains shall be green (PVC) or ductile iron pipe marked with a continuous green stripe located within the top 90 degrees of the pipe.

6.4 TESTING

A) The Contractor shall perform hydrostatic testing of all sanitary sewage force mains, as set forth in the following, and shall conduct said tests in the presence of representatives from the City and/or other authorized agencies with 48 hours advance notice provided.

B) Piping and appurtenances to be tested shall be within sections between valves or adequate plugs, not exceeding 2000 feet with prior approval from the City. Testing shall not proceed until restraining devices are installed. All piping shall be thoroughly cleaned and flushed prior to testing to clear the lines of all foreign matter. While the piping is being filled with water, care shall be exercised to permit the escape of air from extremities of the test section, with additional release cocks provided if required.

C) Hydrostatic testing shall be performed at 100 psi for all sizes of force mains. The testing procedure shall continue for an uninterrupted period of not less than two (2) hours. Testing shall be in accordance with the applicable AWWA provisions for PVC-AWWA Publication M-23 and for DIP-AWWA Standard C600, Section 4. The allowable rate of leakage shall be less than the number of gallons per hour determined by the following formulas:

PVC	DIP
$L = \frac{ND\,p^{1/2}}{7400}$	$L = \frac{SDp^{1/2}}{133{,}200}$

For 100 psi; test: L = 0.00135 ND (PVC)
For 100 psi; test: L = 0.000075 SD (DIP)

L = allowable leakage in gallons per hour
N = number of joints in section tested
S = length of pipe tested, in feet
D = nominal diameter of the pipe in inches
P = average test pressure maintained during the leakage test in pounds per square inch gauge.

1) The testing procedure shall include the continued application of the specified pressure to the test system, for the two hour period by way of a pump taking supply from a container suitable for measuring water loss. The amount of loss shall be determined by measuring the volume displaced from said container.

2) Should the test fail, necessary repairs shall be accomplished by the contractor and the test repeated until within the established limits. The contractor shall furnish the necessary labor, water, pumps, gauges, and all other items required to conduct the required sanitary sewage force main testing and shall perform the necessary system repairs required to comply with the specified hydrostatic test.

3) Pipe sections to be pressure tested shall be subjected to a hydrostatic pressure of 100 psi for a duration of 2 hours by means of a pump.

D) All tapping saddles/valves shall be subject to a one hour pressure test at 125 psi with no allowable leakage.

(Reserved)